COURSE DATA

Data Subject	
Code	34258
Name	Optics II
Cycle	Grade
ECTS Credits	6.0
Academic year	2022 - 2023

Study (s)

Degree	Center	Acad. year	Period
1105 - Degree in Physics	Faculty of Physics	3	Second term

Subject-matter

Degree	Subject-matter	Character
1105 - Degree in Physics	12 - Optics	Obligatory

Coordination

Name	Department
FERRANDO COGOLLOS, ALBERT	280 - Optics and Optometry and Vision Sciences

SUMMARY

This is a theoretical course (no labs) with 6 ECTS allocated for the second quarter of Optics material and natural continuation of Optics I. Its primary objectives are the subject (the students acquire basic knowledge about the behavior of light which have been completing the course in Optics I. In particular, key aspects of the wave nature of light (interference and diffraction) are studied and again the light-matter (diffusion, nonlinear optics) interaction . To complete the subject turns to analyze the light-matter in order to explain the basic mechanisms of laser and other light sources optical interaction interest. Teaching is part of the third year of the degree in physics, along with the materials Electromagnetism and Quantum Physics, and obviously has a direct relationship with the Experimental Techniques Optical. Matter Optics is basic physics and as such, the knowledge that the optical behavior are useful in many other subjects, especially as Regarding the wave behavior. Moreover, this course continues in subjects Electromagnetic Optics and Quantum Optics fourth grade.

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

Previous knowledge acquired in the subject optical Optics I. Knowledge of general math (trigonometry, mathematical analysis, solving simple differential equations, vectors). Very basic knowledge of electromagnetism.

OUTCOMES

1105 - Degree in Physics

- Knowledge and understanding of the fundamentals of physics in theoretical and experimental aspects, and the mathematical background needed for its formulation.
- To know how to apply the knowledge acquired to professional activity, to know how to solve problems and develop and defend arguments, relying on this knowledge.
- Problem solving: be able to evaluate clearly the orders of magnitude in situations which are physically different, but show analogies, thus allowing the use of known solutions in new problems .
- Theoretical understanding of physical phenomena: have a good understanding of the most important physical theories (logical and mathematical structure, experimental support, described physical phenomena).
- Be able to understand and master the use of the most commonly used mathematical and numerical methods.
- Modelling & Problem solving skills: be able to identify the essentials of a process / situation and to set up a working model of the same; be able to perform the required approximations so as to reduce a problem to an approachable one. Critical thinking to construct physical models.
- Physics general culture: Be familiar with the most important areas of physics and with those approaches which span many areas in physics, or connections of physics with other sciences.
- Foreign Language skills: Have improved command of English (or other foreign languages of interest) through: use of the basic literature, written and oral communication (scientific and technical English), participation in courses, study abroad via exchange programmes, and recognition of credits at foreign universities or research centres.
- Learning ability: be able to enter new fields through independent study, in physics and science and technology in general.
- Communication Skills (written and oral): Being able to communicate information, ideas, problems and solutions through argumentation and reasoning which are characteristic of the scientific activity, using basic concepts and tools of physics.

- Students must have acquired knowledge and understanding in a specific field of study, on the basis of general secondary education and at a level that includes mainly knowledge drawn from advanced textbooks, but also some cutting-edge knowledge in their field of study.
- Students must be able to apply their knowledge to their work or vocation in a professional manner and have acquired the competences required for the preparation and defence of arguments and for problem solving in their field of study.
- Students must have the ability to gather and interpret relevant data (usually in their field of study) to make judgements that take relevant social, scientific or ethical issues into consideration.
- Students must be able to communicate information, ideas, problems and solutions to both expert and lay audiences.
- Students must have developed the learning skills needed to undertake further study with a high degree of autonomy.

LEARNING OUTCOMES

- Ability to refer to the basic principles of physical theories and experiments related to optics.

- Ability to build simplified models that describe the object of study with the necessary approximation and allow predictions to be made about its future evolution.

- Ability to use mathematics in a way related to the real world.

- Ability to solve optical problems.

- Ability to learn the state of the art of discipline and its upgrade processes.

DESCRIPTION OF CONTENTS

1. Interference

1.1. The phenomenon of interference.
1.2. Conditions of interference.
1.3. Wavefront division interference: Young's experiment.
1.4. Amplitude division interference.

2. Diffraction

2.1. Preliminary considerations. Far field and near field diffraction .
2.2. Fresnel diffraction.
2.3. Fraunhofer diffraction.

3. The laser

3.1. Einstein's theory of light-matter interaction.
3.2. Stimulated emission. Population inversion.
3.3. The laser. Constituent elements.
3.4. The optical cavity.
3.5. The laser emission.

4. Introduction to nonlinear optics

4.1. The generalized Lorentz model.
4.2. Centrosymmetric media: Kerr effect and third harmonic generation.
4.3. No centrosymmetric media: second harmonic generation and frequency summation and substraction.

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	45,00	100
Tutorials	15,00	100
Study and independent work	45,00	0
Preparation of evaluation activities	15,00	0
Preparing lectures	30,00	0
TOTAL	**150,00**	

TEACHING METHODOLOGY

Contact teaching 40%:

Theoretical and practical classes: It addresses the conceptual and formal matter and resolution of problems or cases as the application of theoretical concepts. They are based mainly on lectures with dialogue and the use of teaching tools such as experimental demonstrations, animations or videos, graphic solutions, design presentations, etc.

Group tutoring sessions or work in small groups: focus on student work and their active participation: resolving doubts in dealing with theoretical concepts and problem solving, reinforcement in areas of greatest difficulty, questionnaires conceptual , experimental demonstrations relevant to the case studies and associated with a component of ongoing evaluation, monitoring of student progress in the field.

Student's personal work 60%:

- Study of the theoretical content.

- Problem solving, both individually and in group.

- Individual tutorials and specific consultations from the student to the teacher about concerns and difficulties encountered in the study and the resolution of problems, or discussion on topics of interest, bibliography, etc.

EVALUATION

The evaluation of this subject will be carried out in two parts:

1) A written examination, including theory and problems, whose maximum grade is 7 points. The theory part will evaluate the understanding of the theoretical and conceptual aspects and the formalism of the subject, both through theoretical questions and through conceptual and numerical questions or simple particular cases. The problems' part will evaluate the ability to apply the formalism to specific cases, as well as the critical analysis of the results obtained. In both parties, a correct argumentation and adequate justification of the results will be assessed.

2) Continuous evaluation, which will assess the work done by the student during the course in the resolution of questions and problems, and in the development of topics, both in the classroom and at an individual level or by means of any other method that supposes an interaction between teachers and students. This activity will be valued at up to 3 points. The percentage (or weight) assigned to each of these activities, on the total grade, will be:

* Exam: Theory 40%. Problems 30%.

* Continuous evaluation: 30%.

If the exam mark (N1) is less than 3.5 (out of 10), this will be the course mark. Otherwise, the mark of the subject will take into account the continuous evaluation mark (N2) in the following way:

max{N1,0.7*N1+0.3*N2}

The course mark in first and second call will be calculated in the same way.

OBSERVATIONS: Provided that the compensation criteria established for this purpose are met, the grade for this subject may be averaged with the grade of the Optics I course.

REFERENCES

Basic

- E. Hecht and A. Zajac. Óptica. Addison Wesley Iberoamericana (1990).
- P. W. Milonni and J. H. Eberly, Lasers. John Wiley & Sons (1988).
- R. D. Guenther. Modern Optics. John Wiley & Sons (1990).